

**Remarks/Arguments**

**I. Received and accepted drawings are acknowledged by Applicants**

Applicants acknowledge Examiner's reception and acceptance of the drawings for the Application as filed March 12, 2004.

**II. Examiner's Numbered Paragraph 1 acknowledged by Applicants**

Applicants acknowledge Examiner's remarks on page 1, paragraph 1, of the Office Action mailed August, 16, 2006 (the "Office Action") and notes the remarks do not specifically require an individualized formal response from the Applicants.

**III. Applicants respond to Examiner's Numbered Paragraphs 2-4 (Claim Rejection 35**

**U.S.C. § 112, ¶2) by Amendment to Claim 10**

In Examiner's paragraphs 2 and 3, Examiner cites to and rejects Claims 10-21 and 26-34 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. The Examiner states in Examiner's paragraph 4:

The term "suitable" in claim 10 is a relative term which render the claims indefinite. The term "suitable" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of invention.

Applicant, in response, has amended Claim 10 to remove the term "suitable" from the claim.

As a result of amending Claim 10, Applicant believes Claim 10 is now in a condition of allowance. Applicant respectfully requests that the Examiner withdraw the rejection of Claim 10 under 35 U.S.C. § 112, second paragraph. Additionally, as Claim 10 is the independent claim from which Claims 13-17, 19-21, and 26-34 depend from, Applicant believes these claims are also in a condition for allowance and respectfully request that Examiner withdraw the rejection of these dependent claims from the rejection under 35 U.S.C. § 112, second paragraph.

**IV. Applicants respond to Examiner's Numbered Paragraphs 5-6 (Claim Rejection 35 U.S.C. § 103(a)) by Amendment and Transversal**

In Examiner's paragraph 5, Examiner states that Claims 10-21 and 26-34 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Joshi, et al. (U.S. Patent No. 5,290,405) ("*Joshi*") in view of Futaki, et al. (Japanese Patent No. 2-199076) ("*Futaki*") and Balagopal, et al. (U.S. Patent No. 5,580,430) ("*Balagopal*"). Examiner states:

With respect to claims 10, 18, 28, 29 *Joshi* teach a process of forming a three layered composite electrolyte comprising tape casing a dense NASICON membrane disposed between two porous NASICON plates. See Column 4, Lines 32-57. However, *Joshi* do not teach the use of pore former material in the two porous NASICON plates. *Futaki* teach a process to make porous ceramic material by adding pore-forming material, such as crushed rice hull or wood flower, to the mixture. See Abstract. Therefore, it would have been obvious to one of ordinary skill in the art to add pore-forming material to the NASICON substrate of *Joshi*, because *Futaki* teach the resulting mechanical properties of the porous ceramic material can be enhanced.

Furthermore, *Joshi* and *Futaki* do not teach the sintering of the laminated composite electrolyte at elevated temperatures. *Balagopal* teach a laminated NASICON composite electrolyte, wherein the electrolyte is sintered at various temperatures to achieve good ionic conductivity. See Column 11, Lines 22-43. Therefore, it would have been obvious to one of ordinary skill in the art to sinter the laminated composite electrolyte of *Joshi* and *Futaki* at elevated temperatures, because *Balagopal* teach good ionic conductivity of the electrolyte can be obtained from the sintering operation.

NASICON is an abbreviation for "sodium super ionic conductor", whereas sodium is represented by its periodic table designation "Na".

Claim 10, as amended, currently reads:

10. A process for forming a three-layered thin film composite solid electrolyte comprising the steps of:

- (a) tape casting a series of sheets or films, each said sheet formed from one of at least two slip composites, each said slip composite containing an electrolyte where the electrolyte of each said slip composite has a coefficient of thermal expansion, said coefficient for each said electrolyte in each said slip composite is identical within +/- 5%, wherein one of the said slip composites is formed with an added combustible pore former (a "Porous Material") and another of said slip composites is formed without said pore former material (a "Non Porous Material");
- (b) laminating said series of sheets to create a layered structure having at least three layers, where said series of layers alternate between layers formed from said Non-Porous Materials and layers formed from said Porous Materials; and
- (c) sintering said layered structure at a final sintering temperature to densify said layer formed from said Non Porous Materials to create an ionically conductive layer, whereas said final sintering temperature is about 1500-1600°C.

Applicant's invention is directed towards a process for forming a composite solid electrolyte wherein one of the steps includes sintering the non porous material to create an ionically conductive layer, whereas the final sintering temperature is about 1500-1600°C. Examiner's rejection of Claim 10 is respectfully traversed for several reasons. Examiner has not provided proper suggestion or motivation for one of ordinary skill in the art to modify the cited art into the steps of Claim 10. Examiner has not provided where one of ordinary skill in the art would know they would succeed in performing the steps of Claim 10 by using the cited art. Examiner has not provided sources that teach or suggest all the claim limitations claimed in Claim 10. The art cited by the Examiner teaches away from the steps given in Claim 10. Finally, the art cited by the Examiner would be rendered inoperable for its intended purpose if exposed to the conditions as claimed in Claim 10. In view of these reasons, Applicant respectfully traverses Examiner's rejection under 35 U.S.C. § 103(a) of Claims 10 as well as the claims which depend from this

independent claim. The non-obvious nature of Claims 10, 13-17, 19-21, and 26-34 will become apparent in the following discussion.

Regarding rejections under 35 U.S.C. § 103(a), to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. See M.P.E.P. § 706.02(j); see also *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

- A. Applicant respectfully submits that the Examiner has not provided any suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify *Joshi*, *Futaki*, or *Balagopal*.

The Examiner made the following statement in rejection of independent Claims 10:

Furthermore, *Joshi* and *Futaki* do not teach the sintering of the laminated composite electrolyte at elevated temperatures. *Balagopal* teach a laminated NASICON composite electrolyte, wherein the electrolyte is sintered at various temperatures to achieve good ionic conductivity. See Column 11, Lines 22-43. Therefore, it would have been obvious to one of ordinary skill in the art to sinter the laminated composite electrolyte of *Joshi* and *Futaki* at elevated temperatures, because *Balagopal* teach good ionic conductivity of the electrolyte can be obtained from the sintering operation.

Applicant respectfully points out that the motivation to modify *Joshi*, *Futaki*, or *Balagopal* must come from one of three possible sources: the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art. *In re Rouffet*, 149 F.3d 1350, 1357, 47 U.S.P.Q.2d 1453, 1457-58 (Fed. Cir. 1998). A statement that modifications of

the prior art to meet the claimed invention would have been "well within the ordinary skill of the art at the time the claimed invention was made" because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. MPEP § 2143.01; *see also Al-Site Corp. v VSI Int'l Inc.*, 174 F.3d 1308, 50 U.S.P.Q.2d 1161 (Fed. Cir. 1999) (The level of skill in the art cannot be relied upon to provide the suggestion to combine references).

Applicant respectfully submits that the Examiner has not provided the source that a person of ordinary skill in the art would derive the motivation from with access to *Joshi*, *Futaki*, and *Balagopal* to modify *any of the references* from their current claimed form into a step where a person sinters a layered structure at a temperature to densify the layer formed from a non porous material to create an ionically conductive layer *where the sintering temperature is about 1500-1600°C*. As stated by the Examiner, *Balagopal* teaches sintering NASICON (sodium super ionic conductor) materials at various temperatures to achieve good ionic conductivity. This view of *Balagopal*, however, does not provide any motivation for one of ordinary skill in the art to elevate the sintering temperature of the laminate composites significantly above normal NASICON sintering temperatures. *Balagopal* also does not provide any motivation to use materials other than NASICON that would operate outside of the NASICON sintering range. As stated in both *Balogopal* and in the Application, NASICON sintering temperatures are below the temperature where sodium oxide is known to sublime ( $\sim 1275^\circ\text{C}$ ). *See Balagopal*, col. 7, lns. 23-24 and Table 1; Application, Detailed Description, page 13. The temperatures claimed in Claim 10 reach beyond this range by hundreds of degrees centigrade. To sinter NASICON materials as described in *Balagopal* and *Joshi* at the temperature range stated in Claim 10, the NASICON materials would likely become diminished as ionic conductors due to significant sodium carrier loss, thereby affecting overall conductivity of the ionic layer. If the proposed modification to the prior art would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984). Additionally, both *Joshi* and *Balagopal* essentially teach the processing of NASICON materials only, not other

materials like forms of  $\beta$ -alumina, as taught by Applicant. To extrapolate the teaching and techniques of *Joshi* and *Balagopal* and substitute them for what would have to be used by one practicing Applicant's process would be an improper substitution. *See In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988); M.P.E.P. § 2143.01 (discussion).

Applicant respectfully suggest that the Examiner has not provided any evidence that motive originates form any of the required sources (i.e., the nature of the problem to be solved, the teachings of the prior art, or knowledge of persons of ordinary skill in the art), but rather from the Examiner's own subjective opinion. Applicant respectfully points out that the Examiner's own subjective opinion is insufficient to support a *prima facie* case of obviousness in regards to Claim 10. *In re Lee*, 61 U.S.P.Q.2d 1430, 1434 (Fed. Cir. 2002).

- B. Applicant respectfully submits to the Examiner has not provided or shown where in the prior art the reasonable expectation of success is for modifying Joshi, Futaki, or Balagopal to make Claim 10.

The Applicant respectfully suggests that the Examiner has not provided citation or reference to any source in the prior art that would guide one of ordinary skill to have a reasonable expectation of success, given *Joshi*, *Futaki*, and *Balagopal*, to create the invention claimed in Claim 10. None of the references cited refer to sintering materials above the sodium oxide sublimation temperature as claimed in Claim 10 to achieve excellent ionic conductivity of the non porous layer. The Applicant respectfully points out that the Examiner must provide evidence from where a reasonable expectation of success would be derived from by one of ordinary skill in the art in modifying *Joshi*, *Futaki*, and *Balagopal* to render Claim 10 obvious. M.P.E.P. § 2143. The Applicant suggests that since the Examiner has not provided where the reasonable expectation of success lies, the Examiner has not presented a *prima facie* case of obviousness in rejecting Claim 10.

- C. Applicant respectfully points out that Joshi, Futaki, or Balagopal, singly or in combination, do not teach or suggest all the claim limitations of Claims 10.

Applicant respectfully asserts that *Joshi*, *Futaki*, or *Balagopal*, taken singly or in combination, does not teach or suggest "sintering said layered structure at a final sintering temperature to densify said layer formed from said Non Porous Materials to create an ionically conductive layer *whereas said final sintering temperature is about 1500-1600°C*," as recited in Claims 10. The Examiner states that *Balagopal* teaches "a laminated NASICON composite electrolyte, wherein the electrolyte is sintered at various temperatures to achieve good ionic conductivity," and that therefore "it would have been obvious to one of ordinary skill in the art to sinter the laminated composite electrolyte of *Joshi* and *Futaki* at elevated temperatures, because *Balagopal* teach good ionic conductivity of the electrolyte can be obtained from the sintering operation."

Applicant respectfully traverses Examiner's rejection on this point. As stated by the Examiner, *Joshi* and *Futaki* do not teach the sintering step at all, so those references are not addressed on this issue. Applicant states that *Balagopal* does not teach or suggest using sintering temperatures in the "about 1500-1600°C" range as given in either the text or examples. Applicant respectfully asserts that *Balagopal* teaches sintering NASICON materials at temperatures ranging from 925-1130°C for time periods ranging from four to eight hours. *See Balagopal*, col. 7, lns. 23-24; Table 1; Figures 13 and 14. The minimum temperature claimed in Claim 10 is "about 1500°C" – far beyond the demonstrated temperatures used for sintering NASICON in *Balagopal* or known in the prior art.

*Balagopal*, as a reference, actually teaches away from using higher temperatures and shorter time periods for sintering based on the desire to avoid creating a second phase inside the sintered structure, unlike as described in the Application. *Balagopal* states:

As sintering temperatures and holding times increase, the opportunity to separate out a second phase increases. Fig. 12a shows how, at a lower temperature, a single phase is in equilibrium while at a higher temperatures below the melting range, two phases are in equilibrium at the same composition. While it is desirable to increase the density, it is undesirable to separate out a second phase as shown in Fig. 12b. It is preferable to increase the sintering temperature and time to increase the density but still maintain a single phase microstructure as shown in

Fig. 12c.

*Balagopal*, col. 11, lns. 29-37, *see also* Fig. 12A (two phases at higher temperatures). *Balgaopal's* data demonstrates this in Figures 13 and 14, where the graphs show material density "flatlining" at the relatively same density value past a certain temperature point. In fact, the data shows that density is more influenced by sintering times to reach the same final density level past a certain temperature point. These statements and data in combination would lead one of ordinary skill reading *Balagopal* to conclude that the sintering step should occur at lower temperatures for longer periods to avoid the dual-phase issue, not higher temperature value. Applicant, instead, specifically claims sintering at about 1500-1600°C and states the advantages of minimizing losses in material sublimation from the newly-formed ionically conductive layer, formation of an excellent electrolyte, and reduction in peak sintering time. *See* Application, Detailed Description, page 13-14. Applicant respectfully suggests that, in view of these arguments, the Examiner has not established the case for *prima facie* obviousness for this claims because all the claim limitations present are not taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974).

Applicant respectfully submits that the Examiner has not met the burden of establishing a *prima facie* case for obviousness in rejecting Claim 10. As such, Applicant respectfully asserts that Claim 10 is now in a condition of allowance. In addition, Applicant respectfully asserts that Claims 13-17, 19-21, and 26-34, which depend from Claim 10. If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

D. Applicant respectfully points out that Joshi, Futaki, or Balagopal, singly or in combination, do not teach or suggest all the claim limitations of Claims 13-17, 19-21, and 26-34.

Claim 13 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Joshi*, *Futaki*, and *Balagopal* as applied to Claim 10 in addition to Claim 13. Examiner states that "*Balagopal* does not teach the use of encapsulation during sintering 1500°C."

Claims 14-16 and 31-34 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Joshi, Futaki, and Balagopal* as applied to Claim 10 in addition to Claims 14-16 and 31-34. Examiner states:

With respect to claims 14-16, 31-34, *Balagopal* do not specifically disclose the sintering steps in the process. However, *Balagopal* recognize the density and phase equilibrium of the ceramic electrolyte are determined by the sintering temperature and hold time. See Column 11, Lines 13-43. therefore, it would have been within the skill of the ordinary artisan to adjust the sintering schedule of the laminated electrolyte in order to yield optimum density and microstructure. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, 617 F.2d 272, 205 U.S.P.Q. 215 (C.C.P.A. 1980).

Claim 17 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Joshi, Futaki, and Balagopal* as applied to Claim 10 in addition to Claim 17. Examiner states that "Joshi teach the electrolyte can comprise beta-alumina."

Claim 19, 20, and 30 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Joshi, Futaki, and Balagopal* as applied to Claim 10 in addition to Claims 19, 20, and 30. Examiner states that "Joshi teach the thickness of the laminate is about 25 $\mu\text{m}$ ."

Claim 21 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Joshi, Futaki, and Balagopal* as applied to Claim 10 in addition to Claims 21. Examiner states that "Joshi teach the dense membrane is supported by two porous thin plates."

Claim 26 and 27 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Joshi, Futaki, and Balagopal* as applied to Claim 10 in addition to in view of Reed for Claims 26 and 27. Examiner states:

*Joshi* do not specifically disclose the addition of a binder a plasticizer in the manufacturing of the composite electrolyte. Nevertheless, it is well known in the

art that binder and plasticizer are necessarily present in the tape casting process as evidenced by J.S. Reed, "Introduction to the Principles of Ceramic Processing", page 397. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is *necessarily present in that which is described in the reference*. In re Robertson, 49 U.S.P.Q.2d 1949 (1999).

Applicant respectfully traverses Examiners' remaining rejections listed in this Subsection and reiterates *in toto* the argument made against the applicability of obviousness via *Joshi*, *Futaki*, or *Balagopal*, either singly or in combination, to render independent Claim 10 obvious. Claims 13-17, 19-21, and 26-34 depend from independent Claim 10. If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

In addition, Applicant respectfully responds to the rejections by pointing out that none of the cited prior art references – *Joshi*, *Futaki*, or *Balagopal* – provide or suggest a motivation, give a reasonable expectation of success, or teach or suggest, either singularly or in combination, all the elements for sintering "said layered structure at a final sintering temperature to densify said layer formed . . . whereas said final sintering temperature is about 1500-1600°C." Applicant suggests that the Examiner has stretched the *Joshi* and *Balagopal* references too far beyond their teachings and suggestions for one of ordinary skill in the art, using these references, to use or modify to generate the steps in Applicants' claims. The Applicant also respectfully suggests that the Examiner has not established the case for *prima facie* obviousness for these claims because all the claim limitations present are not taught or suggested by the prior art.

As a result of the foregoing arguments, Applicant respectfully submits that Examiner has not presented a *prima facie* case for obviousness for rejecting Claims 13-17, 19-21, and 26-34. The Applicant respectfully requests the Examiner to withdraw the rejection of these claims under 35 U.S.C. § 103(a). Applicant respectfully asserts that Claims 13-17, 19-21, and 26-34 are now in a condition of allowance.

**Conclusion**

No new matter has been added. Applicant respectfully submits that Claims 10, 13-17, 19-21, and 26-34 as they now stand are patentably distinct over the art cited during the prosecution thereof.

With the addition of no new claims, no additional filing fees are due. However, Applicant respectfully requests a (1) One Month Extension of Time to File this Response. Enclosed with this report is Form PTO/SB/22 with Extension Fees in the amount of \$60.00 as reflected on the PTO/SB/17 Fee Transmittal. However, if additional fees are due and are not included, the Director is hereby authorized to charge any fees or credit any overpayment to Deposit Account Number 23-2426 of WINSTEAD SECHREST & MINICK P.C.

If the Examiner has any questions or comments concerning this paper or the present application in general, the Examiner is invited to call the undersigned at (214) 745-5632.

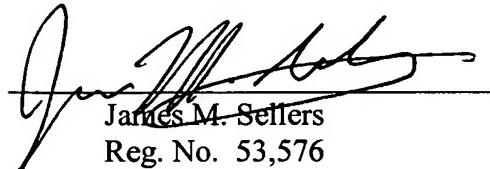
Respectfully submitted,

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